CLAIMS

1. An ultrasonic motor in which radial vibrations of a disc of electro-active material are converted via at least one flextensional displacement amplifier diaphragm into vibrations of the or each diaphragm perpendicular to the plane of the disc, said diaphragm vibrations then being converted into rotary motion via frictional contact at a diaphragm/rotor interface.

2. An ultrasonic motor as claimed in claim 1 wherein the disc of electro-active material is a piezoelectric material, with an electrode of a conductive material deposited on each circular face of the disc.

3. An ultrasonic motor as claimed in 1 wherein the disc of electro-active material is an electrostrictive material, with an electrode of a conductive material deposited on each circular face of the disc.

4. An ultrasonic motor as claimed in 1 wherein the disc of electro-active material is a magnetostrictive material excited by an oscillating magnetic field.

5. An ultrasonic motor as claimed in any preceding claim wherein the disc of electro-active material is of a multi-layer construction with one or more layers of electro-active material interleaved with layers of conductive electrode material.

6. An ultrasonic motor as claimed in any preceding claim wherein the or each flextensional displacement amplifier diaphragm is bonded to the surface of the electro-active disc with an epoxy or a metal loaded epoxy.

7. An ultrasonic motor as claimed in any one of claims 1 to 5 wherein the or each flextensional displacement amplifier diaphragm is bonded to the surface of the electro-active disc with an anaerobic adhesive or modified anaerobic adhesive.

8. An ultrasonic motor as claimed in any one of claims 1 to 5 wherein the or each flextensional displacement amplifier diaphragm is soldered or diffusion bonded to the surface of the electro-active disc.

9. An ultrasonic motor as claimed in any preceding claim wherein a respective diaphragm is attached to each side of the disc and a single rotor positioned opposite one of the diaphragms turns about an axle which is attached to the other diaphragm.

10. An ultrasonic motor as claimed in any one of claims 1 to 8 wherein a respective diaphragm is attached to each side of the disc and a respective rotor is arranged opposite each diaphragm of which one rotor is attached to an axle and the other can slide axially along the axle.

11. An ultrasonic motor as claimed in any one of claims 1 to 8 wherein an axle is attached to the electro-active material disc and one or more rotors turn about said axle on bearings.

12. An ultrasonic motor as claimed in any preceding claim wherein one or more rotors are held in contact with the displacement amplifier diaphragms' oscillating surfaces utilising magnetic attraction, when this magnetic attraction is brought about by the rotors having a remnant magnetic polarisation and the diaphragms being made of ferromagnetic

materials, such as the metals Nickel, Iron and Cobalt and most alloys containing one or more of these metals.

13. An ultrasonic motor as claimed in any one of claims 1 to 11 wherein one or more rotors are held in contact with the displacement amplifier diaphragms' oscillating surfaces utilising magnetic attraction, when this magnetic attraction is brought about by the diaphragms having a remnant magnetic polarisation and the rotors being made of ferromagnetic materials, such as the metals Nickel, Iron and Cobalt and most alloys containing one or more of these metals.

14. An ultrasonic motor as claimed in any one of claims 1 to 11 wherein one or more rotors are held in contact with the displacement amplifier diaphragms' oscillating surfaces utilising magnetic attraction, when this magnetic attraction is brought about by an electromagnet winding.

15. An ultrasonic motor as claimed in any one of claims 1 to 11 wherein one or more rotors are held in contact with the diaphragms by one or more springs.

16. An ultrasonic motor as claimed in 1 wherein the displacement amplifier diaphragm and electro-active disc assembly is the rotating component and the rotor is the stationary component.

17. An ultrasonic motor as claimed in 1 wherein the displacement amplifier diaphragm and electro-active disc assembly is the stationary component and the rotor is the rotating component.

18. An ultrasonic motor as claimed in any preceding claim wherein a layer or structure of an elastic material is attached to the surface of the rotor/diaphragm interface.

19. An ultrasonic motor as claimed in any preceding claim wherein elastic fins are provided at the interface that each have a fin tip which contacts the friction interface such that, the fin tip has an instantaneous rotation about a rotation point not in line with the fin tip contact point in the direction of rotation, thus causing a horizontal friction reaction which drives the rotor on the expansive stroke of the displacement amplifier, yet allows the fin to relax on the downstroke and the fin tip to slide on the friction interface.

20. An ultrasonic motor as claimed in claim 19 wherein the elastic fins make a contact at an oblique angle to the surface of the friction interface between the rotating component and the stationary component.

21. An ultrasonic motor as claimed in claim 19 or claim 20 wherein the elastic fins, which make contact with the friction interface, have one or more curved sections in their length.

22. An ultrasonic motor as claimed in claim 19 or claim 20 wherein the elastic fins, which make contact with the friction interface, have at least two straight sections that are joined in at an angle.

23. An ultrasonic motor in which oscillating vibrations are converted into rotary motion through frictional contact at an interface between relatively rotatable components of the motor wherein one of the components comprises a disc of electro-active material and at least one

flextensional displacement amplifier diaphragm for converting radial vibrations of the disc into oscillating vibrations of the or each diaphragm perpendicular to the plane of the disc.

24. An ultrasonic motor according to claim 23 wherein the other component comprises a further disc positioned opposite at least one diaphragm.

25. An ultrasonic motor according to claim 24 wherein one of the components is stationary and the other component is rotatable relative thereto.

26. An ultrasonic motor as claimed in any preceding claim wherein the or each flextensional amplifier diaphragm is dish-shaped with an upset central region.

27. An ultrasonic motor as claimed in claim 26 wherein the central region is spaced from the plane of the disc.

28. An ultrasonic motor as claimed in claim 26 wherein the central region is contained within the plane of the disc.